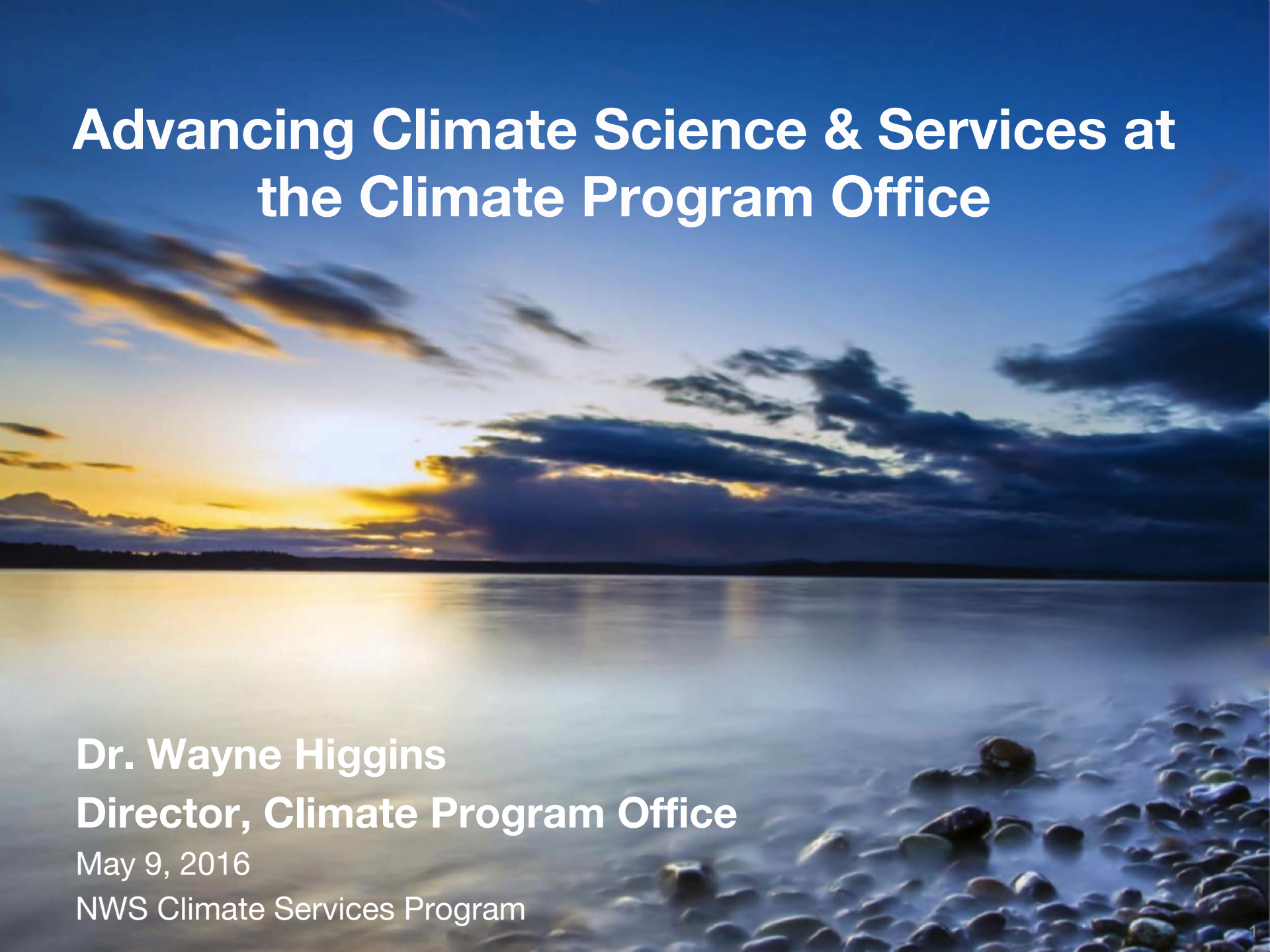
Advancing Climate Science & Services at the Climate Program Office



Dr. Wayne Higgins

Director, Climate Program Office

May 9, 2016

NWS Climate Services Program

Outline

- Increasing Demand for Environmental Information
- Role of NOAA
- Role of OAR / CPO
- OAR-NWS Coordination on End-to-End Climate Services
- Integrated Information Systems
- NOAA Contributions to the Climate Action Plan

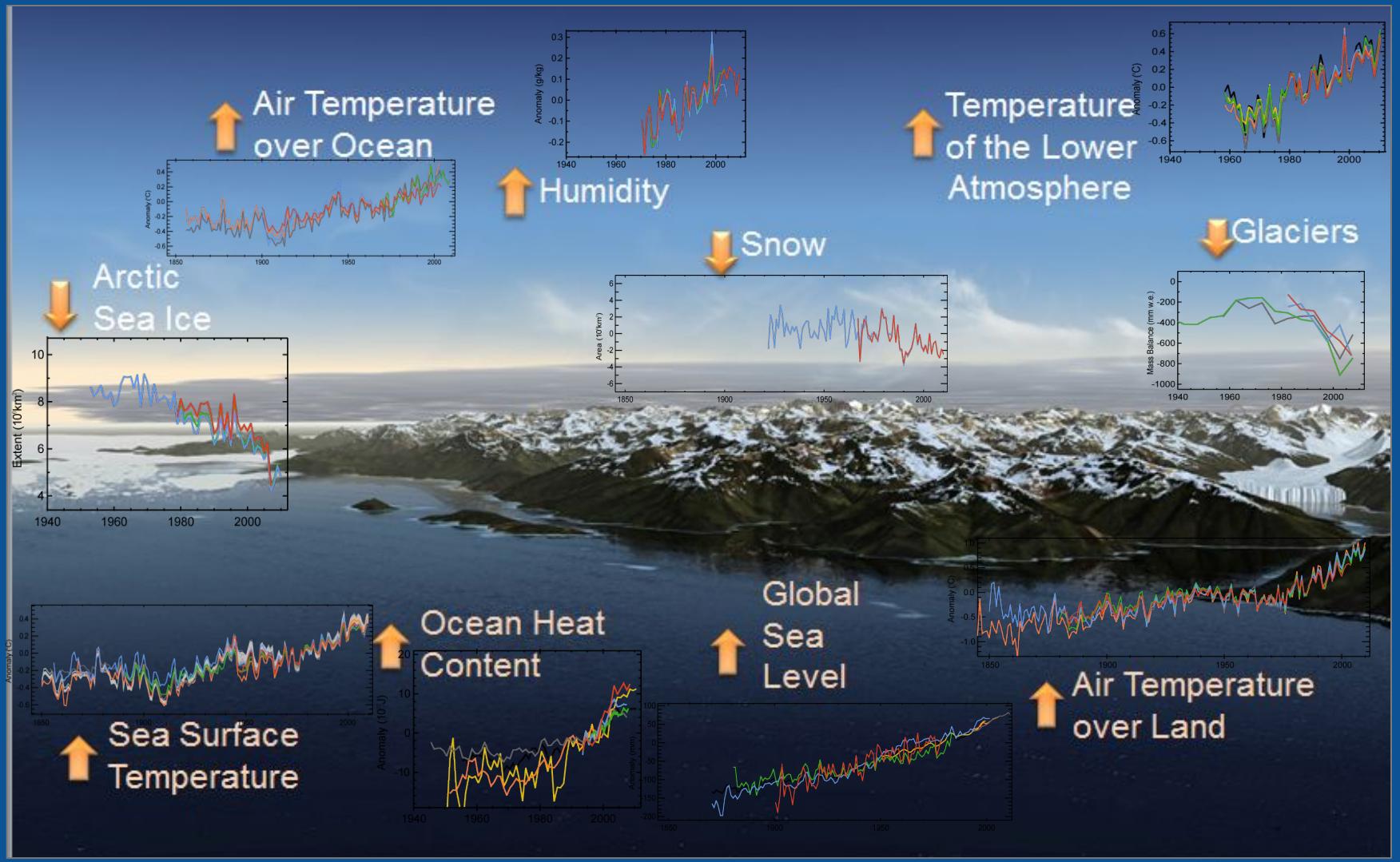
  National Climate Assessment

  Climate Resilience Toolkit

  Global Framework for Climate Services
- Partnerships
- Take Away Messages

What do we know?

Ten Indicators of Changing Conditions:

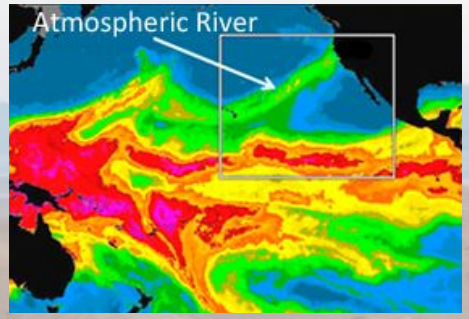


Source: National Climatic Data Center

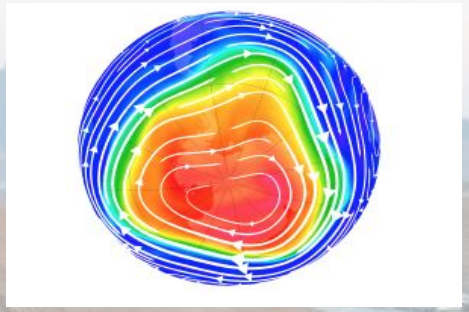
What do we know?

Phenomena that affect climate and extremes from weeks to seasons:

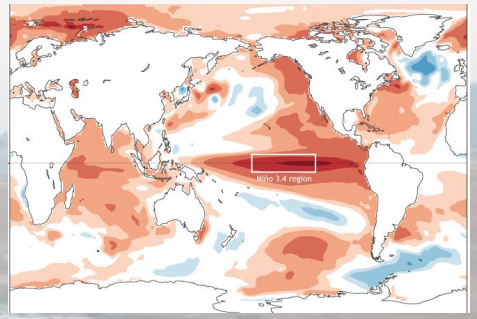
Tropical-extratropical interactions



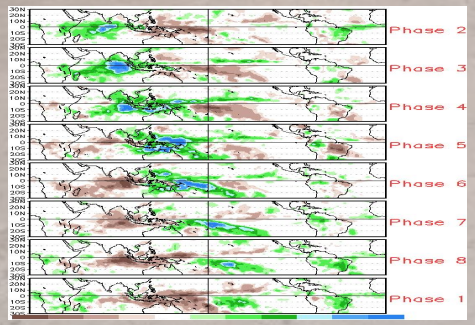
Troposphere-stratosphere interactions



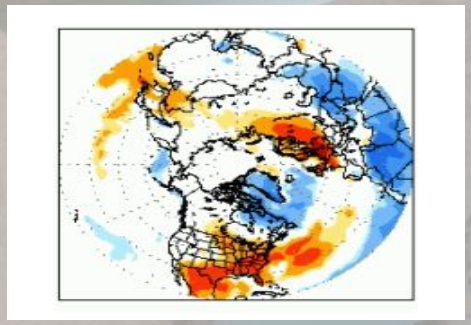
El Niño Southern Oscillation



Madden-Julian Oscillation (MJO)



North Atlantic Oscillation



Ocean-, ice-, and land-atmosphere interactions

WEEKS — SEASONS

Why do we care?

Economies and Livelihoods are at risk


Life and Property


Aviation


Maritime


Space Operations


Forests


Emergency Management


Commerce


Ports


Energy


Hydropower


Reservoir Control

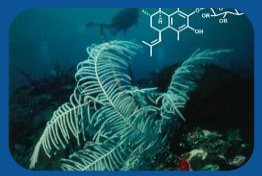

Infrastructure


Construction


Agriculture


Recreation


Ecosystems

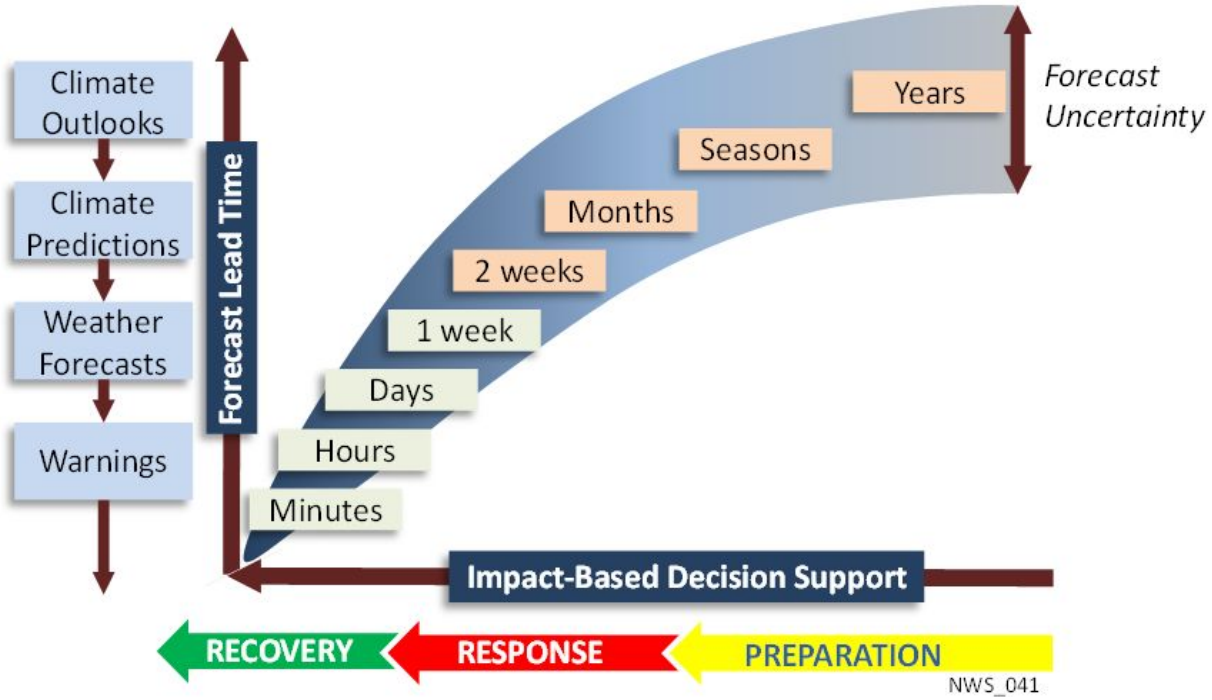

Health


Environment

Careful preparations are required to seize opportunities, and minimize risks and vulnerabilities

What information is needed for decisions?

Timely, credible, useful - across all time scales



e.g. disaster management planning and response

e.g. crop selection, water management

e.g. infrastructure development

What Information is needed for decisions?

A suite of weather and climate products from near term forecasts to long term projections, tailored to stakeholders' needs, to help create jobs, boost economies, and build resilience to extreme events

What is the Role of NOAA?

NOAA provides essential environmental information

Putting environmental information into the hands of people who need it

What is the Role of OAR's Climate Program Office?

VISION

People, businesses, and the environment thriving in the face of climate impacts

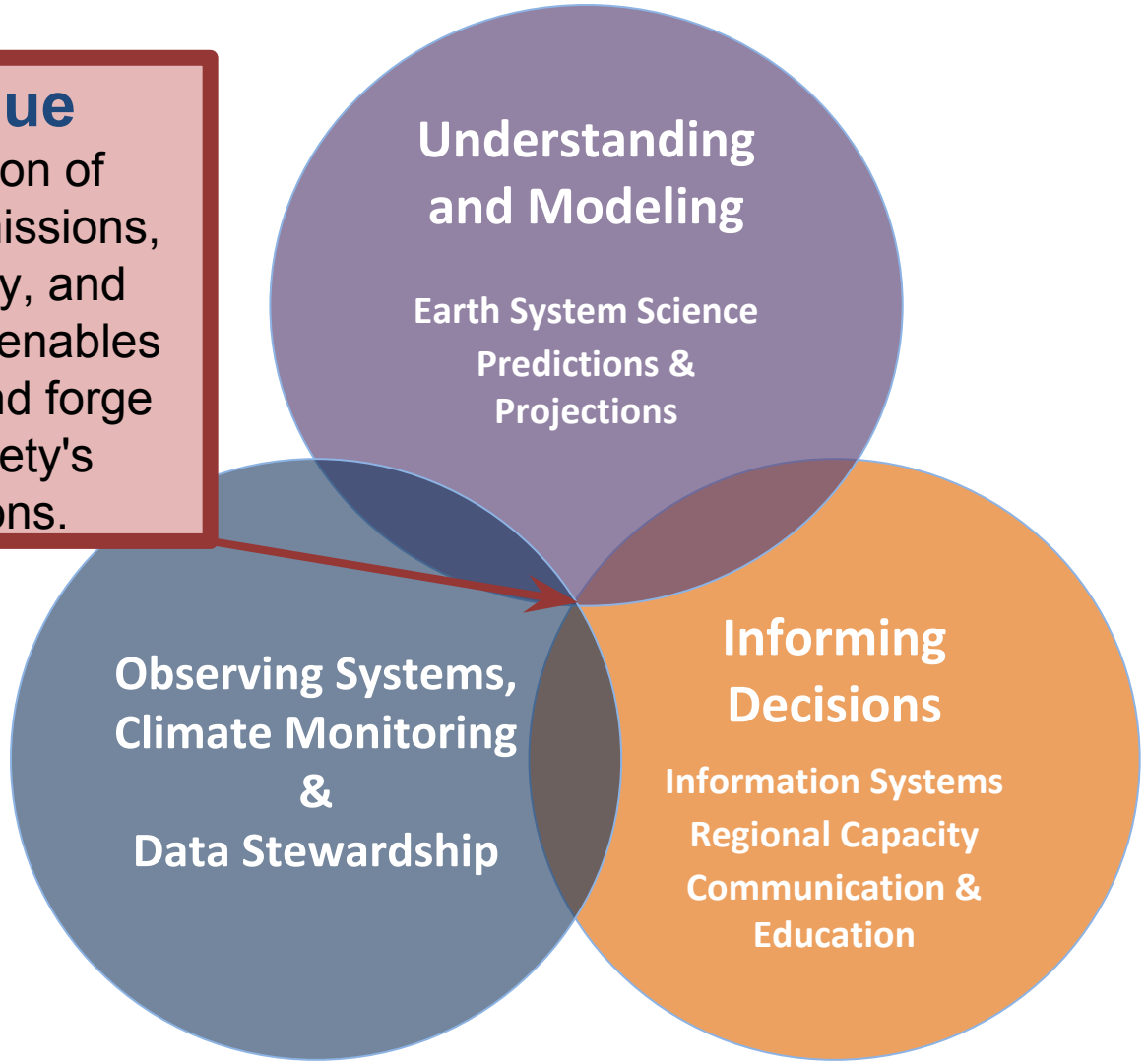
MISSION

We advance scientific understanding, monitoring, and prediction of climate and its impacts to enable effective decisions

What is the Role of OAR's Climate Program Office?

CPO's Unique Value

CPO's position at the intersection of NOAA's science and service missions, the climate research community, and the broader climate enterprise enables it to lead a research agenda and forge partnerships that enhance society's ability to make effective decisions.



CPO Research

One of CPO's key activities is supporting a unique and highly flexible climate research enterprise that focuses on:

- Competitive grant programs and other types of support that advance and extend NOAA's foundational capabilities. Annual FFO.
- Tighter integration between CPO's observing, modeling, earth system science, and decision research
- Research collaboration with OAR labs and programs and other NOAA line
- Partnerships with other federal agencies, academia, the private sector and the international community to develop and deliver targeted research and data products
- Research-derived knowledge and information to improve public climate literacy and decision-making needed to maintain resilient economies and environmental services

FY16 Research Competitions

Climate Observations and Monitoring (COM)

1. *In Situ* Technologies to Contribute to the Tropical Pacific Observing System 2020 Project

Earth System Science (ESS)

2. Atmospheric Chemistry, Carbon Cycle, & Climate (AC4): Fires in the Western US: Emissions and Chemical Transformations
3. Climate Variability & Predictability (CVP): AMOC-Climate Linkages in the N. and/or S. Atlantic

Modeling, Analysis, Prediction, and Projections (MAPP)

4. NOAA Climate Test Bed - Accelerating Transition of Research into Operations
5. Research to Advance Prediction of Subseasonal to Seasonal Phenomena

Climate and Societal Interactions (CSI)

6. COCA – Ecosystem Services for a Resilient Coast in a Changing Climate
7. RISA – Regional Integrated Sciences and Assessments - Existing Regions
8. RISA – Regional Integrated Sciences and Assessments - New Regions
9. SARP – NIDIS: Coping with Drought
10. SARP - Water Resources and Extreme Events

OAR-NWS Coordination on End-to-End Climate Services

- FY15: MOU signed
- FY16: CPO and NWS designed a NWS requirement-by-requirement approach, with key subject matter experts in both LO's, to identify gaps and transition projects to address the gaps.
  - ✓ 3 Types of Projects:
    - Continuations of multi year grants
    - New projects based on NWS requirements (~15 projects)
    - New grants
  - ✓ Examples of New Projects based on NWS requirements:
    - Reanalysis
    - CFSv3
    - Subseasonal-to-Seasonal prediction
    - Climate products (e.g. LCAT; CMORPH)
    - Service Provision (Intl Desks; expertise for Climate.gov)

Connecting Observations to Services at CPO

Observing Systems

- The ocean and Arctic observing systems provide information for climate research and prediction, and also for weather, ecosystems, commerce, and the environment.

Data and Products

- The wider use of the observing system and related data and products should be even better emphasized to address current and evolving climate challenges.

Leadership

- NOAA supports nearly half of global ocean observations and is a leader in the global ocean observing community; that leadership is expanding into the Arctic and other areas.
- CPO is committed to:
  - maintaining world-class climate research, observations, data and products, and
  - providing useful products and services to decision makers
  - communicating the value and impact of the climate observing system

NOAA Priority: Linking Environmental Intelligence to Resilience for Societal Challenge Priority Areas

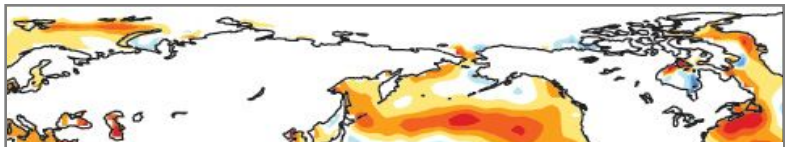
Coastal Inundation

Drought and Water Resources

Extremes

Marine Ecosystems

Integrated Information Systems

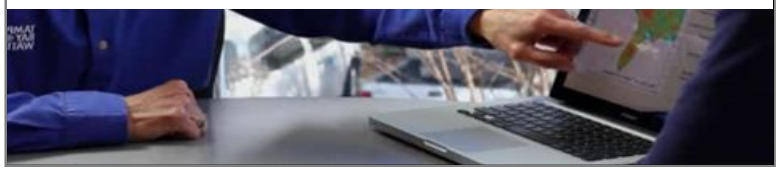


Research, Monitoring, Observation, and Forecasting

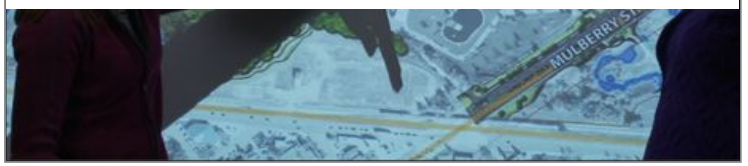
Impacts and Assessments

INTEGRATED INFORMATION

Communication and Outreach



Planning and Preparedness



Integrated Information Systems involve the systematic collection and analysis of relevant information about and coming from areas of impending risk to inform development of strategic responses to anticipate risks and opportunities

National Integrated Drought Information System (NIDIS) Act Tasks

(Public Law 109-430, 2006; 113-086, 2014)

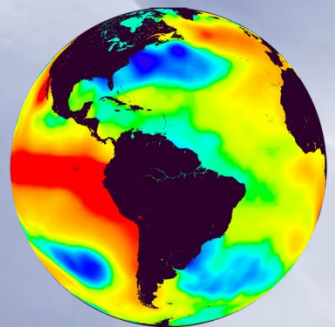
"Enable the Nation to move from a reactive to a more proactive approach to managing drought risks and impacts"

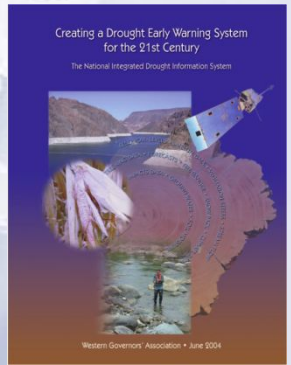
(I) **Provide effective drought early warning systems**

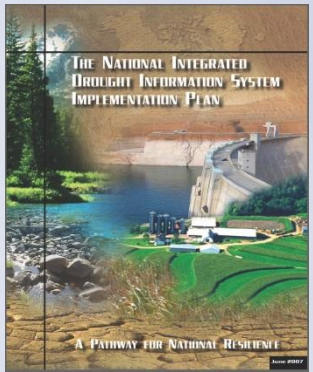
(a) collect and integrate key indicators of drought severity and impacts; and (b) produce timely information that reflect local, regional, and State differences;

(II) **Coordinate and integrate as practicable, Federal research in support of a drought early warning system**

(III) **Build upon existing forecasting and assessment programs and partnerships**



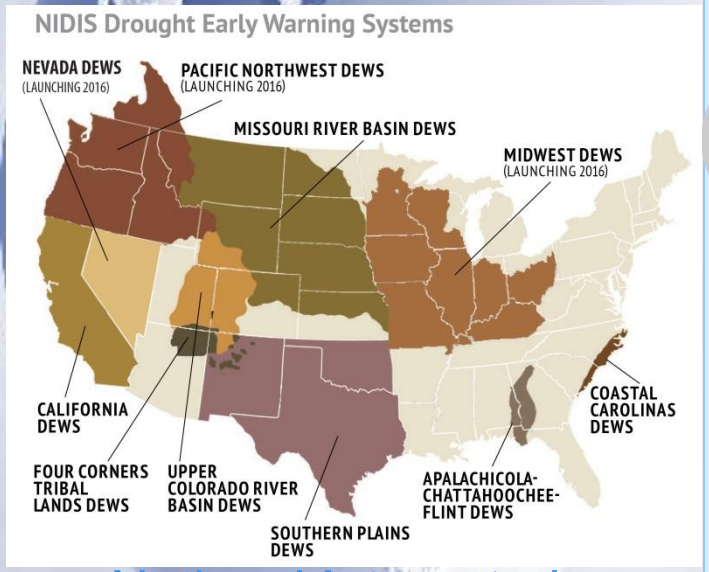




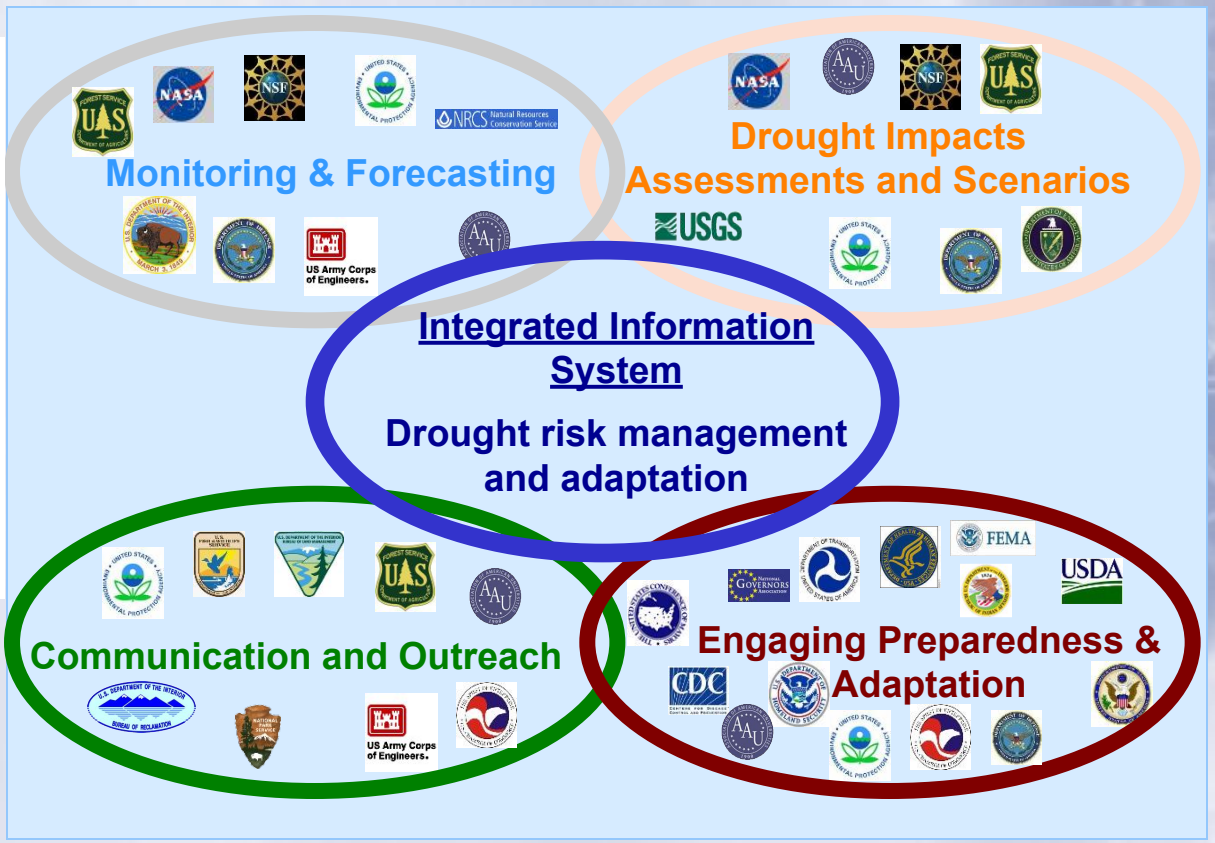
NIDIS
NATIONAL INTEGRATED DROUGHT INFORMATION SYSTEM

Regional Drought Early Warning Information Systems (Linking intelligence to users to enhance resilience)

- State drought planning
- RISA networks
- NWS Forecast Offices
- Tribal engagement



National Integrated Drought Information System (NIDIS)



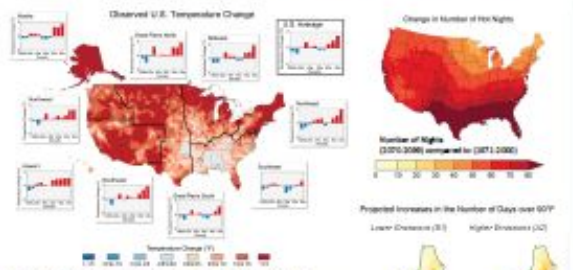
The National Integrated Heat Health Information System (NIHHIS)

Building Societal Resilience to Extreme Heat with Integrated Climate Research, Observations, Predictions, and Partnerships

Jones, Hunter M.[1]; Trtanj, Juli[1]; Hawkins, Michelle[2]; Luber, George[3]; Higgins, Wayne[1]; Pulwarty, Roger[1]

[1]NOAA Climate Program Office (CPO), [2]NOAA National Weather Service(NWS), [3]CDC Climate and Health Program

Extreme Heat is a Societal Challenge



Above: the observational record shows a clear warming trend in most parts of the U.S. over the past two decades (map) and century (histograms) compared to the 1901-1960 average. Right: the number of extremely hot nights and days is projected to increase compared to the 1970–2000 average.

The latest National Climate Assessment (NCA) found that:

Extreme heat events will be more frequent, more intense, and longer in duration in the future.

"What now seems like an extremely hot day will become commonplace."

Vulnerable populations experience greater risk

Exposure to extreme heat can increase discomfort and fatigue, cause heat cramps, and increase emergency room visits, hospitalizations, and death (CDC). In fact, from 1999 through 2009, extreme heat exposure caused or contributed to more than 7,800 deaths in the U.S. (Kochanek et al., 2011).

There are a number of populations with increased vulnerability to extreme heat including the elderly, pets, athletes, children, and outdoor workers. An increase of thousands to tens of thousands of premature deaths is projected per annum as a result of heat extremes by the end of the century. (Schwartz et al., 2015)

NOAA & CDC: NIHHIS Improves Resilience

DEFINE DEMAND

NOAA and the CDC sustain continuous engagement between climate and health communities to identify needs, develop and evaluate solutions, and inform decisions.

OBSERVE AND MONITOR

NOAA works to enhance current heat forecasts based on user need and epidemiological requirements to extend heat projections from weeks to months and beyond.

ENHANCE FORECASTS

NOAA works to enhance heat forecasts based on user need and epidemiological requirements to extend heat projections at all time scales.

UNDERSTAND AND COMMUNICATE

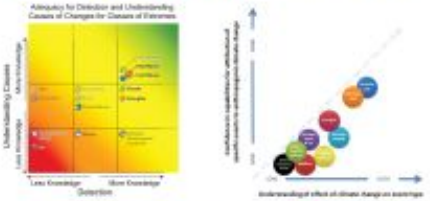
NOAA and the CDC enhance understanding and impact of extreme heat events, build capacity, and develop timely and accessible communication tools to inform preparedness and adaptation.

NOAA and the CDC are developing NIHHIS to:

Facilitate an integrated approach to resilience and provide a suite of decision support services

to reduce heat-related illness and death.

NIHHIS is built on firm scientific footing



Heat waves are well understood and well simulated by climate models - supported by a wealth of observations. Confidence in attribution analyses of specific events and attribution findings of anthropogenic influence is high for extreme heat events. Improved prediction of - and societal resilience to - extreme heat is achievable.

For more information, visit :
http://cpo.noaa.gov/nihhis

Local Engagement to Understand Needs

Local NIHHIS engagements have started in many U.S. regions in order to understand the local experience of extreme heat and to share lessons learned far and wide – including domestic agencies, NGOs, the private sector and a global network of partner cities and nations.

Vulnerability to extreme heat is a complex issue;

Requiring regional to local understanding and benefiting from broad knowledge sharing

to map the entire problem domain and develop effective solutions.

Core questions across the NIHHIS network

Institutional Capacity & Partnerships

What institutional partners have you engaged to help define the needs (esp. bridging disciplines: health, env. science, emergency management); is that sustainable and if so, how and why?

Heat Parameters & Health Outcomes

What heat parameters (tmax, tmin, heat index, etc...) are most important for which specific population and in what geographic conditions?

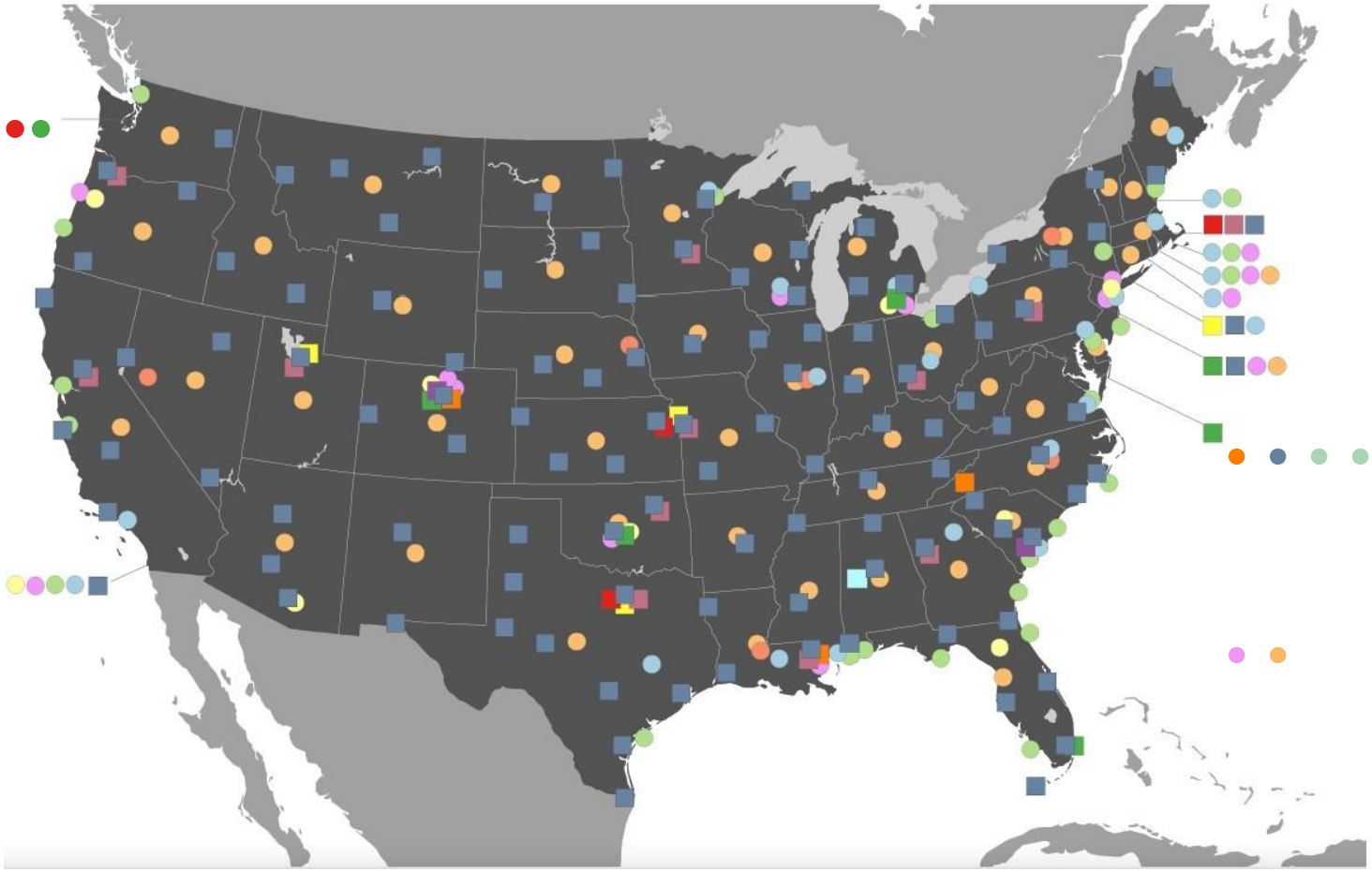
Engagement and Communication Strategies

What communication strategies are most effective both during an event and for long lead time planning (seasonal outlooks)?

Data and Forecast Products

What data and forecast products, indicators, and monitoring is needed (at what resolution & lead time), and what is currently being used by health professionals to make decisions?

Climate Engagement Entities



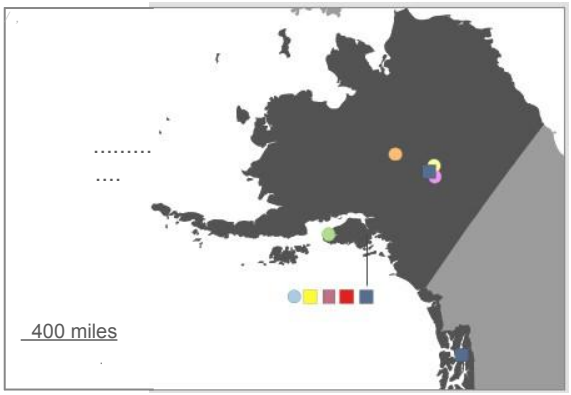
NOAA

- NWS National Water Center
- NWS Regional dimate Services Directors
- Laboratories
- NWS River Forecast Centers
- Data and Prediction Centers
- NWS Regional Headquarters
- Program Offices and Headquarters
- NWS Weather Forecast Offices

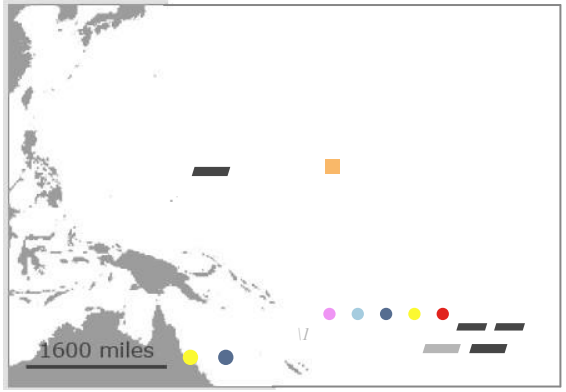
NOAA Partners

- Sea Grant
- National Estuarine Research (NERR)
- Cooperative nstitutes
- Regional Climate Centers
- RISA
- State Climatologist

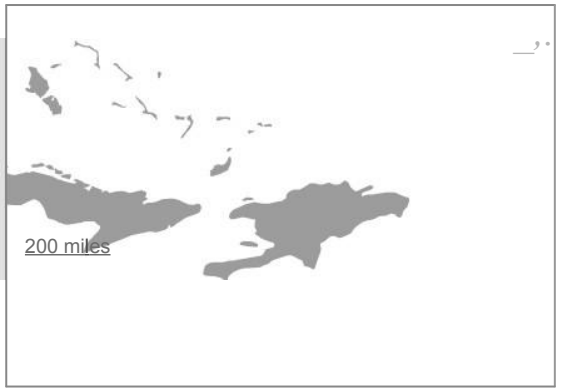
Alaska



PacificIsland Locations



Puerto Rico



NOAA is structured to have multiple entry points at regional, state, and local levels

CLIMATE COORDINATION TEAM

CLIMATE COMMUNICATIONS

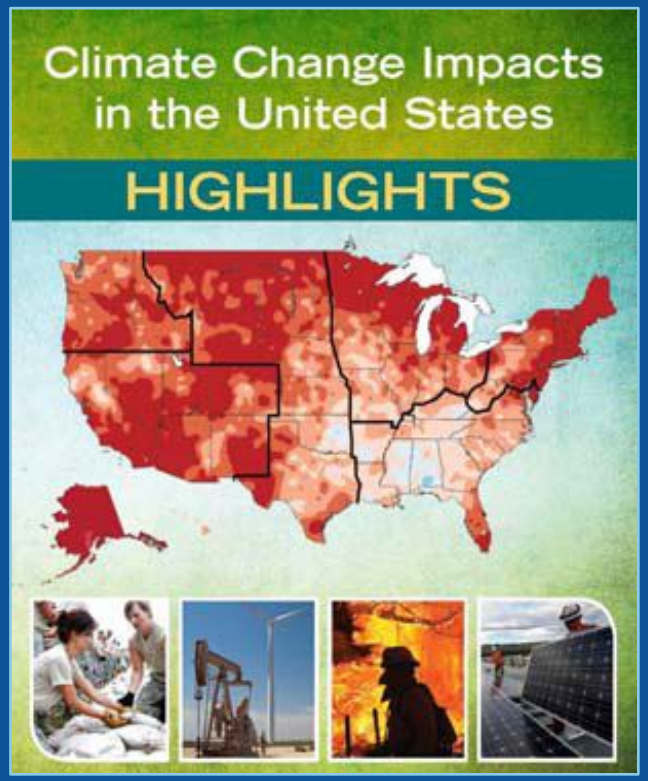
In May 2015, the NOAA Climate Board asked the Climate Coordination Team (CCT): **"Is the information provided by NOAA climate entities consistent across the agency and is this network of climate information outlets effective and efficient?**" To answer this question, the team first identified the entities within NOAA that supply climate information to the public (see next page). Next, the CCT designed an approach to answering the following constituent questions:

- Where does the public (including other governmental agencies as well as other NOAA Line Offices) go for NOAA climate information?
- Is there duplication or overlap in sources and/or answers?
- Is information provided consistently across the agency?
- Is NOAA providing climate information in a coordinated, efficient, and effective manner?

The CCT agreed to complete four case studies to answer these question while also informing a future, more detailed study, if necessary.

How does NOAA contribute to the Climate Action Plan?

Example: Support the National Climate Assessment (NCA)



- NCA is a comprehensive & authoritative scientific report about climate changes that are happening now in the U.S., and that can be expected in the future.
- NCA is required every 4 years under the Global Change Research Act (1990). A key deliverable of USGCRP.
- NOAA's science & observations are an integral part of global efforts to monitor Earth's climate, and have greatly informed the NCA
- NCA-4 is in progress (due out FY18 Q3). Special Reports (Climate and Human Health; Carbon Cycle; Climate Science)
- White House/OSTP documents on "globalchange.gov" and "whitehouse.gov"

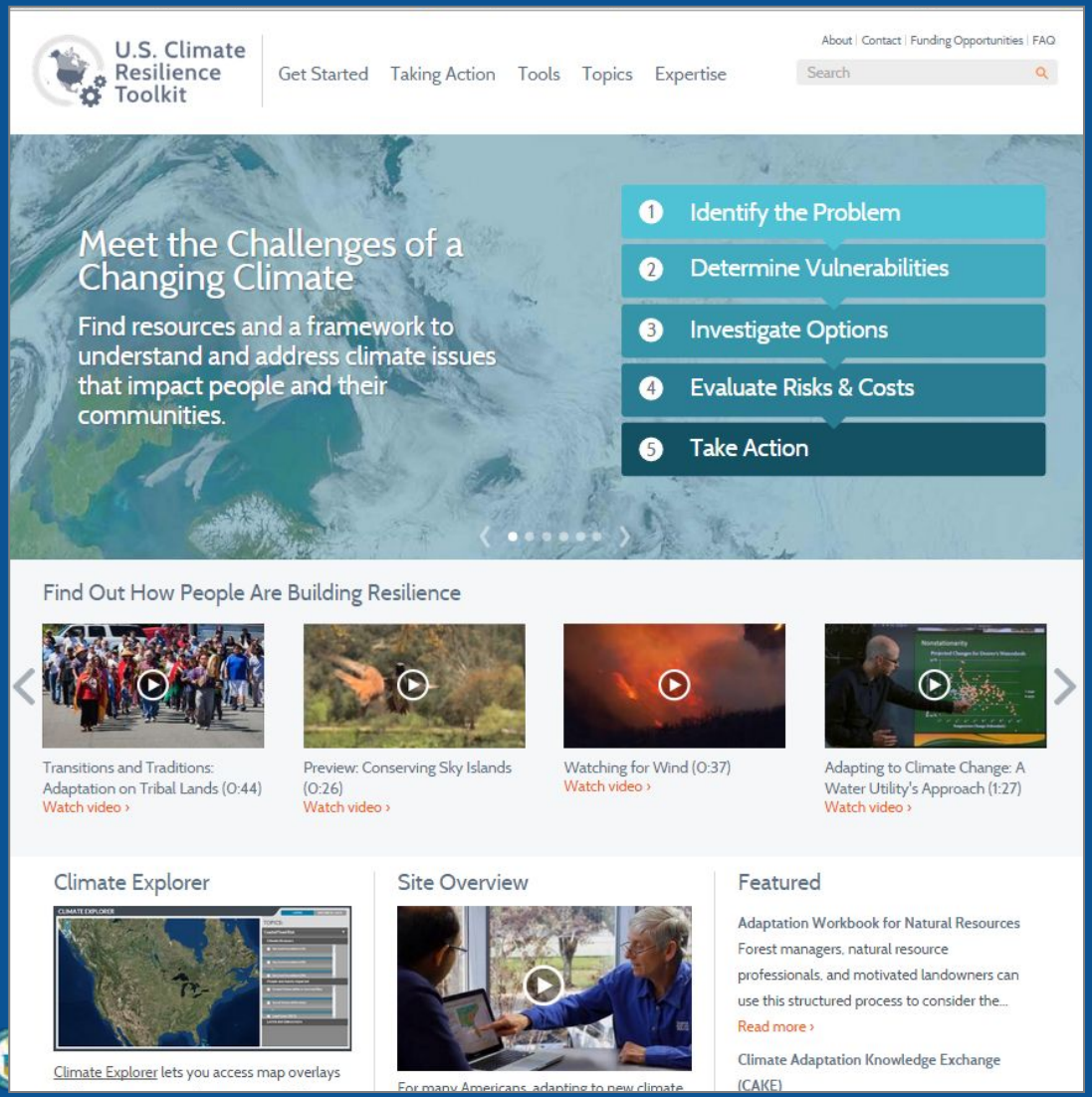
How does NOAA contribute to the Climate Action Plan?

Example: 2014 NCA - Resources for Educators:

- The Climate Program Office's Climate.gov Education team along with collaborators from inside and outside of Government, has released new digital guides that connect educators to relevant findings of the NCA for each U.S. region.
- Link: http://www.climate.gov/teaching/2014-national-climate-assessment-resources-educators
- NOAA, USGCRP NCAnet Education Affinity Group and members of the CLEAN Network have developed this series of guides for educators

How does NOAA contribute to the Climate Action Plan?

Example: Climate Resilience Toolkit (CRT)



toolkit.climate.gov

The CRT v1.0 was first published in Nov 2014.

Serves "application-oriented professionals" — municipal planners, resource managers, & business leaders — who are seeking science-based tools, information, & expertise to help them build resilience.

Climate Data Initiative

climate.data.gov

- Raw materials for analysts, developers, and **data innovators**
- Climate, weather, and demographic data in **machine accessible** formats
- **Technical resources** for analysts, GIS specialists, etc.

Climate Resilience Toolkit

toolkit.climate.gov

- Summary-level scientific information provides context for **decision makers**
- **Case studies** and **tools** for adaptation efforts
- **Decision framework** for adaptation
- Access to regional **expertise** and **training** resources

Climate Resilience Toolkit (CRT) Phase 1

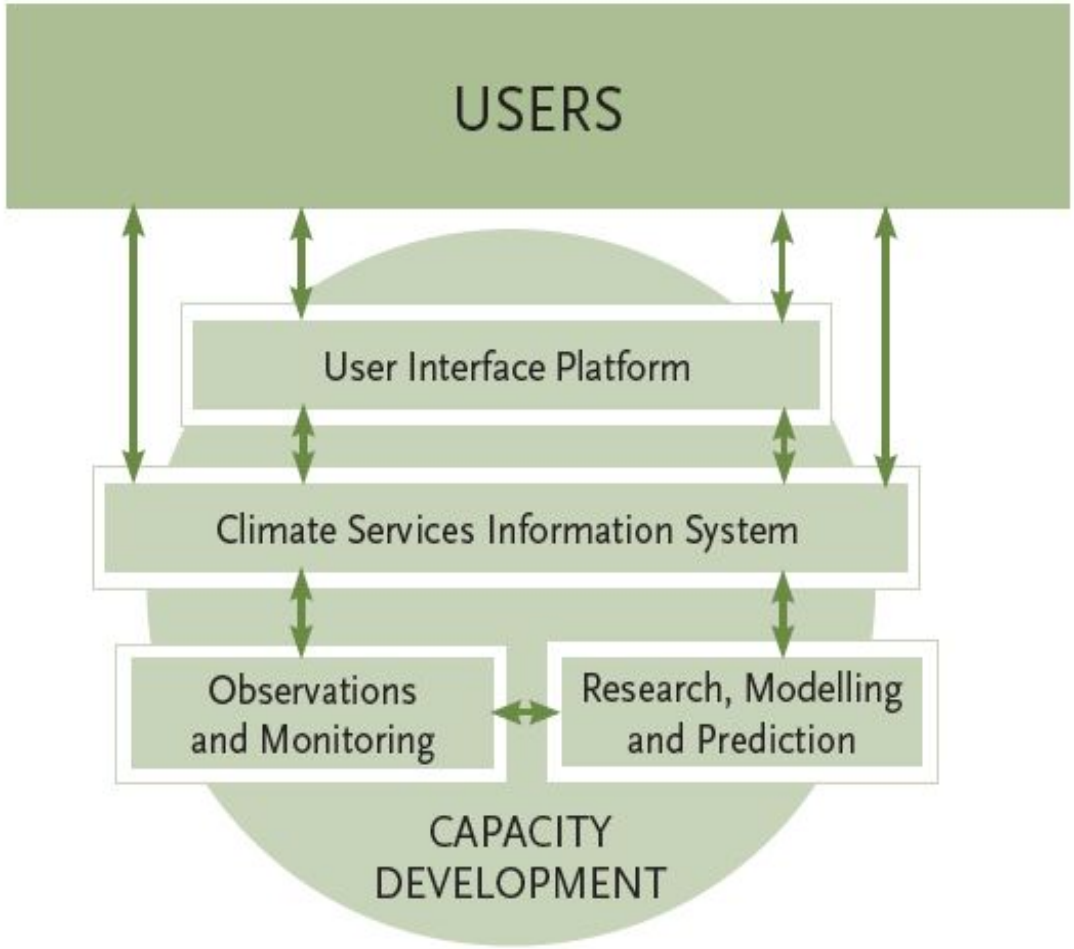
- **Nine** topic narratives with subtopic sections built, all cross-walked with 5-step planning process, tools, & case studies
  - Arctic
  - Coastal Flood Risk
  - Ecosystem Vulnerability
  - Energy Supply and Use
- **98 case studies** nationwide for all regions & topics (more on the way)
  - Food Resilience
  - Human Health
  - Transportation and Supply Chain
  - Tribal Nations
  - Water Resources
- **221 tools** in our compendium (more on the way)
- Averaged about 33,000 visits per month in first year; **over 40,000 visits/month** in our 2nd year (so far)

Climate Resilience Toolkit (CRT) Phase 1.5

- Established new “Climate Projections” team, led by USGCRP; adding decision-relevant climate projections downscaled to county resolution
- Multiple stakeholder engagements held & more planned
- New site-wide design “refresh” coming in April 2016
- New “Marine Ecosystems & Fisheries” section in May 2016
- New “Reports” section coming in June 2016
- New “Regions” section coming in June 2016
- Climate Explorer v2.0 coming in June, with Climate by Location graphing functionality

How does NOAA contribute to the Climate Action Plan?

Example: The Global Framework for Climate Services



Five Priority Areas:

- Water Resources
- Food Security/Ag
- Human Health
- Disaster Risk Reduction
- Energy

Critical Issues:

- Communication of GFCS
- Operations & Resource Plan
- Accounting for national activities
- Sustainability and legacy

US Support to GFCS Implementation (May 2016)

- **GFCS IBCS Management Committee activities and actions**
  - US Gov lead negotiator (Higgins)
  - Operations and Resource Plan (ORP; co-led by Muth)
  - Mid-term Review
- **Potential Support for Communications**
  - NOAA has extensive experience with communications
    - Sharpen core GFCS messages; Increase visibility
    - Ensure that the ORP is well communicated
- **Designation of contributing projects to the GFCS project database**
  - Global observations, research, modeling and prediction
- **Contributions to priority areas**
  - Health – Support for WMO Health Strategy (Trtanj); NIHHIS (Trtanj)
  - NWS (e.g. International Desks; Met Svc Meetings – Senegal; Tanzania) (Thiaw)
- **US engagement in Regional Climate Centers**
  - Polar; Pacific Islands; RAIV (Caribbean, North America, Central America)
- **Climate Services Toolkits, CSIS**

Partnerships are essential

MUTUAL PRIORITIES supported, leveraged and pursued

Regional Priorities

- Drought
- Aging water infrastructure
- Knowledge gaps
- Evolving conditions
- Assessment

Competitive Research

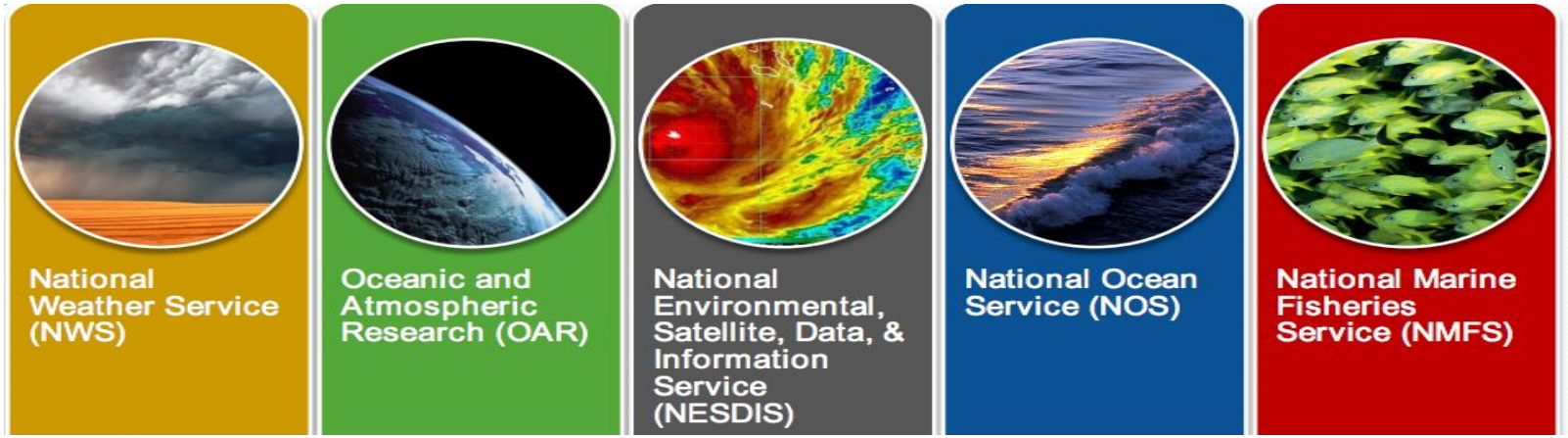
- Mutual priorities
- Science policy innovations
- Focused, traceable projects

National / International Priorities

National Priorities

- Mission/Mandate
- Core capabilities
- Funding
- USGCRA

What is the Outcome? End-to-End capabilities linking environmental intelligence to resilience



- Observing Systems, Climate Monitoring, and Data Stewardship
- Understanding and Modeling
- Predictions and Projections
- Assessments
- Informing Decisions
- Communication and Education

Research

Services

Take Away Messages

- **CPO is advancing climate science and service**
  - CPO programs to improve the global observing system, advance understanding of the Earth system, improve models and forecasts, and communicate, educate, and engage are a unique federal investment in end-to-end climate capabilities.
- **CPO is accelerating transition activities**
  - Service Level Agreement between OAR and NWS to address key NWS climate requirements
- CPO knits these investments together into **Integrated Information Systems** that link climate intelligence to resilience for key societal challenge priority areas
  - Extremes
  - Drought/Water Resources
  - Coastal Flooding
  - Marine Ecosystems.

Extras

Take Away Messages

- **OAR-NWS coordination on End-to-End climate services is improving**
  - **Service Level Agreement between OAR and NWS to address NWS climate requirements**
  - **Accelerate the transition of OAR research advances to NWS operations**

- **CPO sponsored climate research and decision-support science is building resilience to extreme events, boosting economies, and creating jobs.**

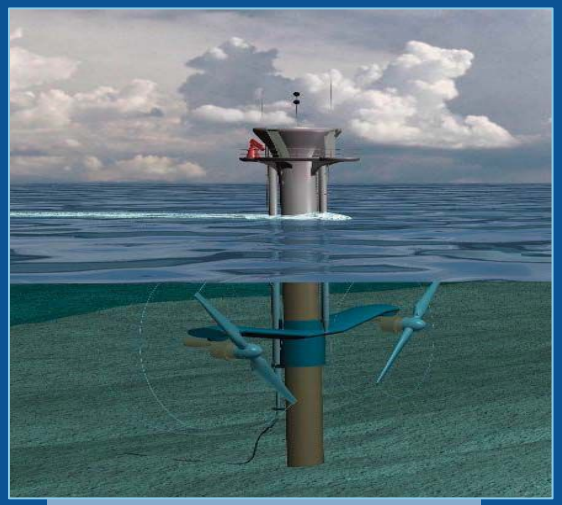
- **CPO's climate portfolio addresses phenomena across a continuum from less than a day (e.g. tornadoes), to weeks (e.g. heat waves) and years (e.g. drought; El Nino).**

- **CPO programs to improve the global observing system, advance understanding of the Earth system, improve models and forecasts, and communicate, educate, and engage are a unique federal investment in end-to-end capabilities.**

- **CPO knits these investments together into Integrated Information Systems that inform early warning to early action.**

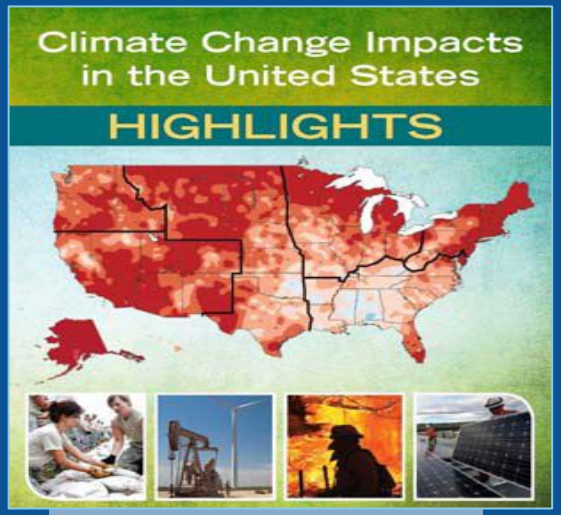
How does NOAA contribute to the President's Climate Action Plan?

We provide science and services in key areas



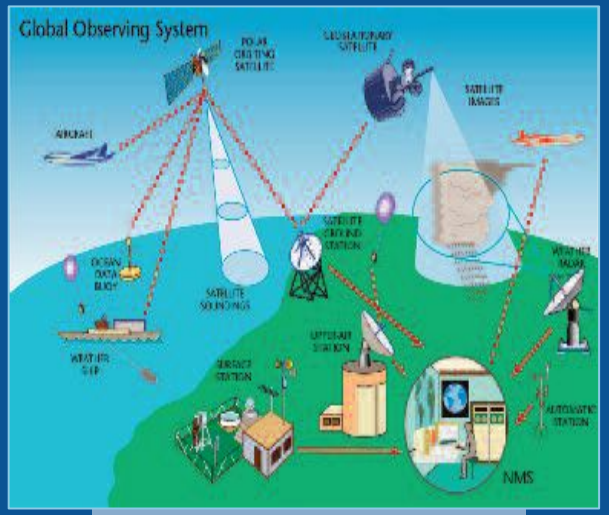
Mitigation Activities

- Quantify greenhouse gas emission
- Protecting coastal ecosystems (Blue Carbon)
- Researching Wind solar and marine energy



Adaptation Activities

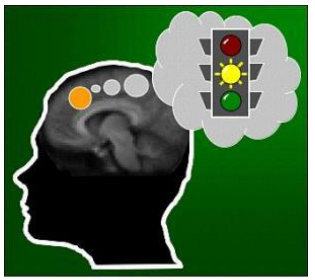
- Actionable scientific data and insights
  - *Drought, Coastal flooding, Arctic*
  - *Ocean Acidification, Fisheries*
- Assessments of climate impacts
- Making climate information available
  - *Climate.gov*
  - *Climate Resilience Toolkit*
  - *Climate.data.gov*



International Cooperation

- Global obs, research, modeling
- Applied climate research & services
  - Early Warning Systems
  - Regional Climate Outlook Forums
- Monitor greenhouse gases
- Capacity building
  - International Training Desks
- International negotiations

What is an Integrated Information System?



……..Informs early warning to early action

The systematic collection and analysis of relevant information about and coming from areas of impending risk that:

(a) Inform the development of strategic responses to anticipate risks and opportunities and their evolution; and
(b) Communicate options to critical actors for the purposes of decision-making and response

An “investment” not an “expenditure”